INVESTIGATING PLANETARY SOILS

About This Lesson

Students working in teams will read paragraphs describing the soil samples and record information on the appropriate chart. Students will then examine and test unknown soil samples and record test observations. Using the charts, each unknown sample will be identified. Students will be asked to defend their decisions.

Objectives

Students will:

- extract pertinent information from written soil descriptions. They will organize information using a fact chart.
- examine characteristics of three soils or soil simulants.
- identify soils by matching the given descriptions with their own observations of the soil properties.
- identify properties of soils from different bodies in our solar system and note similarities and differences.

Background see *Soil Information Sheet*

Soil Samples

1. Obtain Lunar and Mars simulants from **Johnson Space Center, Houston, Texas, 77058, Attention: Carl Allen C23.** (Allow several weeks. Simulants are free in small quantities. Cost of shipping is charged for larger quantities.)
2. Earth soil that is red or brownish orange can be found outdoors in many parts of the country. You will need to write your own description if you are not using a typical east Texas orange soil.

Vocabulary

properties, robotic, analyze, simulant, composition, meteorite, impact, organic, mare, texture

Apollo 17 astronaut using rake to collect small lunar rock samples.

Materials

- ❑ Student Sheets, one each per group, *Soil Information Sheet*, *Chart of Known Soil Data*, and *Chart of Unknown Soil Properties* (pgs. 13-16)
- ❑ transparencies of the handouts (optional)
- ❑ sets of 3 soil samples (1 set per group) each set contains Mars simulant, Lunar simulant, Earth soil (in containers - bottles, vials, or jars)
- ❑ 1 magnet per group (Protect the magnet with thin paper so that it is easier to remove fine particles.)
- ❑ 1 magnifier per group
- ❑ 1 metric ruler per group

Procedure

Advanced Preparation

1. Obtain soil simulants.
2. Make copies of Student Sheets.
3. Prepare sets of 3 soil samples. Label them #1, #2, #3. Keep a record Sample Key.
4. Assemble and distribute equipment per Classroom Procedure.

Classroom Procedure

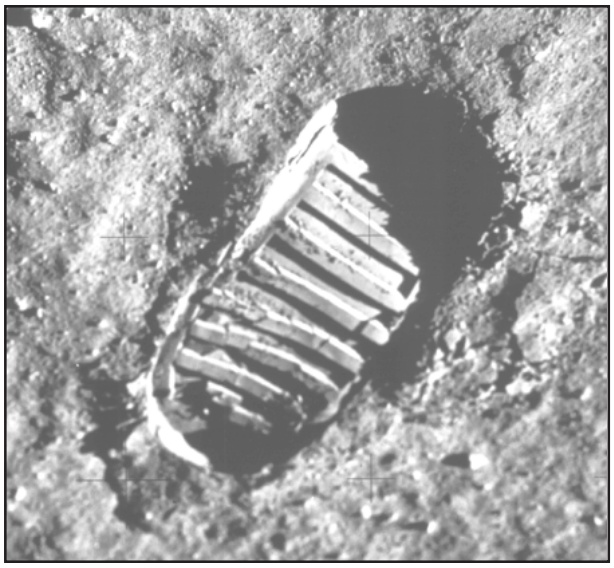
1. Divide the class into groups (3-4 per group).
2. Explain to the students that they are going to be acting as real scientists. Scientists need to be very organized and often keep their information in charts. Students will record data in chart form.
3. Hand out *Soil Information Sheet* and the *Chart of Known Soil Data*. Have the class or teacher read the introduction. Groups read the soil description paragraphs and fill in the chart (10 to 20 minutes).
4. Hand out the *Chart of Unknown Soil Properties* and the three unknown soil samples. Direct students to examine the samples and record their observations. Students should refer to the previous chart to aid their data collection on unknown samples.
5. Using the information from both charts, ask the students to decide which known sample matches which unknown sample. Record the names at the bottom of the *Chart of Unknown Soil Properties*.
6. Lead a discussion that examines the similarities and differences in the soil properties.

   - For some classes, comparing the samples with the chart could be done as a class.
   - For more advanced students, the reasoning behind the choices could be debated either verbally or in writing.
   - Ask students to write their own description of the properties of a different soil sample, possibly samples they have provided.

Apollo astronaut collecting lunar rocks with tongs, on Apollo 12.

TRICKY TERRAIN
SOIL INFORMATION SHEET

Human and robotic trips to the Moon have returned a few hundred kilograms of rocks and soil. Spacecraft have landed on the Mars surface and analyzed the soil, but no samples have been returned from the red planet. In order to become better prepared for future visits to both the Moon and Mars, scientists use the information already known about these planetary bodies. The information helped scientists find material on Earth for use as substitutes for the Moon and Mars soils. These substitutes, called soil simulants, are used to test equipment and techniques for future space exploration.

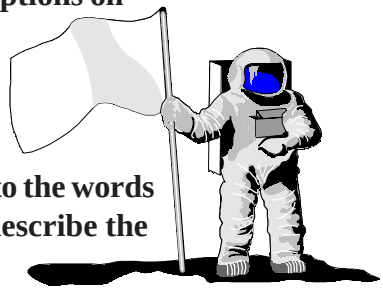


Top: *Apollo 11 footprint on the Moon.*
Bottom: *The surface of Mars taken from the Viking Lander.*

What is commonly called dirt is sample material for scientific studies. Scientists have special ways to study soils. Scientists determine the composition of the soils by using advanced scientific equipment. Many kinds of soils form in our solar system. Data from instruments on spacecraft help scientists know more about the soils of other planets. Everything in our solar system formed from similar materials. Similar processes formed Earth and other parts of our solar system. Therefore, scientists are able to find soils on our planet that fairly closely match the soils of the Moon and Mars.

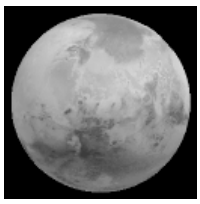
Lunar soil is composed of rock that has been broken and melted by meteorite impacts. Mars soil is probably volcanic material, altered by contact with water. Earth soil is also the product of weathered rock minerals, but usually it also has organic material from dead plants and animals.

• Read the descriptions on the next page and complete the *"Chart of Known Soil Data."* Pay special attention to the words scientists use to describe the soil materials.



JSC-1 The Moon

JSC-1 is a powder made from crushed volcanic ash. The ash erupted from a volcano in Arizona. JSC-1 is uniformly dark gray in color. Most of the powder is very fine, with an average size of 0.1 mm. The finest portion can be separated from the coarser material by repeated shaking. The finer material looks slightly lighter gray than the coarser material. Chunks larger than 1 mm are generally masses of the fine powder, easily broken down with moderate pressure. The powder contains a small percentage of material that can be separated using a magnet. JSC-1 closely matches the color, size, and composition of soil in the mare areas of the Moon.



JSC Mars-1

JSC Mars-1 is a powder made from weathered volcanic ash. The ash was erupted from a volcano in Hawaii. JSC Mars-1 is orange-yellow in color. Individual particles are smaller than 1 mm. The finest portion can be separated from the coarser material by repeated shaking. The finer portion is considerably more yellow than the coarser material. The powder contains about fifty percent dark material which can be separated using a magnet. JSC Mars-1 closely matches the color and approximates the size and composition of soil in the bright areas of Mars.

Earth ET-1

Earth ET-1 is from Polk County in East Texas. It is not volcanic. Earth ET-1 is orange in color. Most particles are bigger than 1 mm in size. The finest portion can be separated from the coarser material by repeated shaking. There is no difference in color between the fine and coarse material. A very small percentage of the material can be separated from the rest using a magnet. Some organic material may be present. Earth ET-1 is only one of many different soils on our planet.

STUDENT SHEET

TRICKY TERRAIN — CHART OF KNOWN SOIL DATA

Read all paragraphs on *Soil Information Sheet.* Record the information about each known soil sample in the space below.

Properties	JSC Mars 1 (Mars)	JSC - 1 (Moon)	Earth ET - 1 (Earth)
What happens when a magnet is put in the soil?			
What color is the soil?			
What color are the very small pieces (particles) of soil?			
How big are the particles of soil? measure in mm			
Does the soil stick together (cling)?			
How do you divide the smaller particles from the big pieces?			

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STUDENT SHEET

TRICKY TERRAIN — CHART OF UNKNOWN SOIL PROPERTIES

Examine the three unknown soil samples using the techniques and information from the *Chart of Known Soil Data.*
Record your detailed observations of the properties of the unknown samples below.
In the lines provided at the bottom, write the sample name from the *Chart of Known Soil Data* that most closely matches your observations.

Observed Properties

Magnetism (give a quantity in percent or at least try to say how much i.e. most or little)			
Color - overall			
Particle size - mm			
Color - fine particles			
Texture (clumps or not)			
Describe what happens when the soil sample is shaken vigorously.			
Write the sample name that matches the properties you have observed. Use the soil names from the *Chart of Known Soil Data.*	**Unknown # 1** _____	**Unknown # 2** _____	**Unknown # 3** _____

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